

US Patent Application Serial No. 09/921,022
Amendment Dated 7/24/04
Reply to Office Action Dated 3/24/2004

Remarks

Claims 1-7 and 12-21 are pending in the application and are presented for reconsideration. Claims 1-7 and 12-21 have been amended. No new matter has been added.

The amendments to the claims more particularly point out the claimed invention as applied to integrated circuit output drivers for controlling the slew rate of output signals on an output pad of an integrated circuit using drive transistors with different threshold voltages to step-control the transition edges of the output signal.

Claim Rejections

Claims 1, 3-4, 7, 12, 14-15, and 18-21 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Gotou (U.S. Pat. No. 5,747,854).

Claims 2, 5-6, 13 and 16-17 stand rejected under 35 U.S.C. § 103(a) as being unpatentable by Gotou in view of Vajapey et al (U.S. Pat. No. 5,877,647).

The Examiner's rejections of the claims are respectfully traversed.

1. Legal standard for Rejecting Claims Under 35 U.S.C. §102/103

Under 35 U.S.C. § 102, a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros., Inc. v. Union Oil Co.*, 814 F.2d 628 (Fed. Cir.), *cert. denied*, 484 U.S. 827 (1987).

The standard for obviousness under 35 U.S.C. §103 is whether the claimed invention would have been obvious to those skilled in the art in light of the knowledge made available by the reference or references. *In re Donovan and Ryan*, 184 USPQ 414, 420, n. 3 (CCPA 1975). It requires consideration of the entirety of the disclosures of the references. *In re Rinehart*, 189 USPQ 143, 146 (CCPA 1976). All limitations of the claims must be considered. *In re Boe*, 184 USPQ 38, 40 (CCPA 1974). In making a determination as to obviousness, the references must be read without benefit of Appellants' teachings. *In re Meng*,

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181 USPQ 94, 97 (CCPA 1974). In addition, the propriety of a 35 U.S.C. §103 rejection is to be determined by whether the reference teachings appear to be sufficient for one of ordinary skill in the relevant art having the references before him to make the proposed substitution, combination, or other modifications. *In re Lintner*, 173 USPQ 560, 562 (CCPA 1972).

In order to combine references, the references must suggest the combination. *In re Bond*, 15 USPQ2d 1566, 1568 (CAFC 1990) ("Obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination.") (quoting *Carella v. Starlight Archery and Pro Line* 231 USPQ 644, 647 (CAFC 1986)). There is no suggestion to combine, however, if a reference teaches away from its combination with another source. *Tec Air Inc. v. Denso Manufacturing Michigan Inc.*, 52 USPQ2d 1294, 1298 (Fed. Cir. 1999) (citing *In re Fine* 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1597 (Fed. Cir. 1988)); See also *Winner International Royalty Corp. v. Wang*, 53 USPQ2d 1580, 1587 (Fed. Cir. 2000) ("If [the cited reference] does in fact teach away from [Applicant's invention], then that finding alone can defeat [an] obviousness claim." (annotation added)). A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant . . . [or] if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant." *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994).

In addition, if when combined, the references "would produce a seemingly inoperative device," then they teach away from their combination. *Tec Air*, 52 USPQ2d at 1298 (citing *In re Sponnoble*, 405 F.2d 578, 587, 160 USPQ 237, 244 (CCPA 1969)); See also *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984) (finding no suggestion to modify a prior art device where the modification would render the device inoperable for its intended purpose).

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The suggestion to combine references must have been in the prior art at the time Applicant's invention was made. *W. L. Gore & Associates, Inc. v. Garlock, Inc.*, 220 USPQ 303, 312 (CAFC 1983), *cert. denied*, 469 U.S. 851 (1984). The mere absence from a reference of an explicit requirement of the claim cannot reasonably be construed as an affirmative statement that the requirement is in the reference. *In re Evanega*, 829 F.2d 1110, 4 USPQ2d 1249 (Fed. Cir. 1987).

"The decisionmaker must view the prior art without reading into that art appellant's teachings. The issue, then, is whether the teachings of the prior art would, in and of themselves and without the benefits of appellant's disclosure, make the invention as a whole, obvious." *In re Nomiya, Kohisa, and Matsumura*, 184 USPQ 607, 612 (CCPA 1975) (citations omitted) (quoting *In re Sponnoble*, 160 USPQ 237, 243 (CCPA 1969)).

2. Response to Rejections of Claims Under 35 U.S.C. § 102/103

a. *Claims 3-6*

Applicant's amended claim 3 recites:

An output driver that drives an output signal onto an output pad of an integrated circuit, comprising:

a first switchably conductive device characterized by a first threshold voltage of a given polarity, said first switchably conductive device coupled between said output pad of said integrated circuit and a voltage source and having a control input connected to a driving signal to allow current conduction from said voltage source to said output pad when a voltage level of said driving signal is equal to and greater than said first threshold voltage and to disallow said current conduction when said voltage level of said driving signal is less than said first threshold voltage; and

a second switchably conductive device independent from said first switchably conductive device characterized by a second threshold voltage of said given polarity greater than said first threshold voltage, said second switchably conductive device coupled between said output pad of said integrated circuit and said voltage source and having a control input connected to said driving signal to allow current conduction from said voltage source to said output pad when a voltage level of said driving signal is equal to and greater than said second threshold voltage and to disallow said current conduction when said voltage level of said driving

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signal is less than said second threshold voltage;
wherein said first switchably conductive device and said second
switchably conductive device together operate to control the slew rate of
said output signal driven onto said output pad of said integrated circuit
using a step-controlled edge transition.

The Gotou Reference

The Examiner cites Gotou as anticipating claim 3. In particular, the Examiner points to FIG. 33 (which is schematically identical to embodiment of FIG. 11) and seeks to equate Gotou's N1 with Applicant's first switchably conductive device, and Gotou's N2 with Applicant's second switchably conductive device.

Claim 3 has been amended to more particularly point out that the claimed invention is for an output driver for reducing the slew rate of an output signal on an output pad of an integrated circuit.

Gotou does not teach “[a]n output driver that drives an output signal onto an output pad of an integrated circuit”. Gotou describes a semiconductor device that includes at least two adjacent regions which have different threshold values and each of which has a discrete channel region of a first conductivity type, a common source and a common drain of a second conductivity type with the discrete channel region disposed therebetween, and a common gate formed above the discrete channel region. With this structure, the operation speed of the circuit can be maintained, the through current between power and ground reduced, and the power consumption of the circuit lowered.

Gotou describes many different embodiments of the device, including a MOS transistor (FIGS. 5A, 5B, 7A, 7B), a CMOS inverter (FIGS. 9A, 9B), a CMOS inverter (FIG. 11), a NAND gate (FIG. 31), and a NOR gate (FIG. 32).

In FIGS. 5A, 5B, and 7A, Gotou shows, respectively, a P-channel and N-channel MOS transistor formed of at least two adjacent regions formed in a semiconductor substrate having two different threshold values. The N-channel MOS transistor 15 in FIGS. 7A and 7B is formed of a first region B1 having a low threshold value VTH and a second region B2 having a high threshold value VTH.

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Although the equivalent circuit diagram shown in FIG. 7B of the N-channel MOS transistor of FIG. 7A shows a pair of N-channel FETs coupled in parallel between a first node and a second node, each with the same drive signal applied at their gates, there is nothing in Gotou to suggest that the drains of the N-channel FETs are coupled to drive "an output signal onto an output pad of an integrated circuit". Rather, throughout the text and figures of Gotou, it is clear that the purpose of the MOS transistors shown in FIGS. 5A, 5B, 7A, and 7B is for use in a logic gate that generates through current during a state transition. The purpose of the MOS transistors shown in FIGS. 5A, 5B, 7A, and 7B is to reduce the through current during state transitions of the logic gates and to reduce power consumption of the circuits thereby.

In each embodiment including the CMOS inverter (FIGS. 9A, 9B), CMOS inverter (FIG. 11), NAND gate (FIG. 31), and NOR gate (FIG. 32), the device is a particular respective logic gate that performs a particular respective logic function. None of these devices are used in output drivers to pull an output pad of an integrated circuit high or low. However, each of these devices is used as part of the structure of a logic device that generates through current between power and ground during a state transition. In other words, in each use of the MOS transistor, there is at least one standard or additional MOS transistor implemented in accordance with Gotou's embodiment in FIGS. 5A, 5B or 7A, 7B connected in series with the MOS transistor between a power source and ground. The purpose of Gotou's MOS transistor is to reduce the amount of through current between power and ground during a state transition of the overall logic structure without compromising speed.

As previously stated, there is no suggestion in Gotou that any of the described embodiments are used as a driver circuit that "drives an output signal onto an output pad of an integrated circuit". Per *In re Evanega, supra*, as an explicit requirement of claim 3, the absence from Gotou of an output pad of an integrated circuit cannot be reasonably construed as an affirmative statement that the requirement is in the reference.

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Gotou does not teach "a first switchably conductive device characterized by a first threshold voltage of a given polarity, said first switchably conductive device coupled between said output pad of said integrated circuit and a voltage source and having a control input connected to a driving signal to allow current conduction from said voltage source to said output pad when a voltage level of said driving signal is equal to and greater than said first threshold voltage and to disallow said current conduction when said voltage level of said driving signal is less than said first threshold voltage" as recited in Applicant's claim 1. As described above, Gotou does not teach or suggest that the n-channel MOS transistor 15 is coupled between an output pad of an integrated circuit and a voltage source. To the contrary, Gotou teaches the use of the n-channel MOS transistor within the structures of larger logic devices that exhibit through current during state transitions, and not the use of the n-channel MOS transistor as a pulldown device in an output driver as in Applicant's claimed invention. The logic gates shown in Gotou, including a CMOS inverter, a NAND gate and a NOR gate are not standard components used as pullup or pulldown devices in an output driver.

Gotou does not teach "a second switchably conductive device independent from said first switchably conductive device characterized by a second threshold voltage of said given polarity greater than said first threshold voltage, said second switchably conductive device coupled between said output pad of said integrated circuit and said voltage source and having a control input connected to said driving signal to allow current conduction from said voltage source to said output pad when a voltage level of said driving signal is equal to and greater than said second threshold voltage and to disallow said current conduction when said voltage level of said driving signal is less than said second threshold voltage" as recited in Applicant's claim 1. As described above, Gotou does not teach or suggest that the n-channel MOS transistor 15 is coupled to drive an output pad of an integrated circuit. To the contrary, Gotou teaches the use of the n-channel MOS transistor within the structures of larger logic devices

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that exhibit through current during state transitions, and not the use of the n-channel MOS transistor as a pulldown device in an output driver as in Applicant's claimed invention.

Gotou also does not teach or suggest "wherein said first switchably conductive device and said second switchably conductive device together operate to control the slew rate of said output signal driven onto said output pad of said integrated circuit using a step-controlled edge transition". Again, Gotou does not teach or suggest that the MOS transistor with differing threshold voltages drives an output signal onto an output pad of an integrated circuit.

Since Gotou does not meet each and every limitation of Applicant's claim 3, per *Verdegaal Bros., Inc., supra*, Gotou cannot be used in formulating an anticipation rejection under 35 U.S.C. § 102.

Gotou alone also cannot be used in formulating an obviousness-type rejection under 35 U.S.C. § 103. As stated in *In re Gurley, supra*, a reference may be said to teach away from an applicant's invention when a person of ordinary skill, upon reading the reference, would be led in a direction divergent from the path that was taken by the applicant. Because each demonstrated use of Gotou's MOS transistor is shown in a series connection between power and ground *for the purpose of reducing through current between power and ground during state transitions*, and not for the purpose of reducing the slew rate of an output signal on an output pad of an integrated circuit, Gotou actually teaches away from Applicant's use of a plurality of switchably conductive devices, each characterized by different threshold voltages, coupled in parallel between an output pad of an integrated circuit and a voltage source.

The Vajapey Reference

Vajapey does not make up for the deficiencies of Gotou in meeting Applicant's claim 3. The Applicant repeats the arguments presented in the Applicant's Responses to the previous two Office Actions, which in summary explain that Vajapey does not teach or suggest at least the use of a "second

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switchably conductive device ... characterized by a second threshold voltage of said given polarity greater than said first threshold voltage".

Although Vajapey does disclose a pair of FETs (N1 and N2, FIG. 2) coupled between an output pad (174) of an integrated circuit and ground (152), Vajapey cannot be combined with Gotou in meeting Applicant's claim 3 because Vajapey uses two separate drive signals ON1 and ON2 to respectively drive the gates of FETs N1 and N2. The separate drive signals ON1 and ON2 operate to delay the turn-on of FET N2 after the turn-on of FET N1. If Gotou were combined with Vajapey, FET N2 would be delayed in turning on due first to the time delay in turning ON2 on, and then additionally due to the higher threshold voltage of N2 (due to the combination of Gotou with Vajapey's circuit). This would increase the delay between turning on N1 and N2 greater than Vajapey intended, rendering Vajapey inoperative for its intended purpose. In addition, if N2 had a higher threshold voltage than N1, as in Gotou, Vajapey's circuit would be unnecessary. Accordingly, Vajapey teaches away from combination with Gotou. Accordingly, per *Winner International Royalty Corp.*, *supra*, ("If [the cited reference] does in fact teach away from [Applicant's invention], then that finding alone can defeat [an] obviousness claim." (annotation added)), Gotou cannot be combined with Vajapey to properly form even a § 103 rejection of Applicant's claim 3.

Summary

Accordingly, in view of the above and repeating the prior prosecution history to date, neither Gotou, Vajapey, nor any of the other prior art of record, taken either alone or in any combination, meets each and every limitation of Applicant's claim 3. Per *Verdegaal Bros., Inc.*, *supra*, therefore neither Gotou, Vajapey, or any of the other prior art of record can be used in formulating an anticipation rejection under 35 U.S.C. § 102. Furthermore, none of the references of record, as described above, may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 3 should be

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withdrawn and that claim 3 is now in position for allowance.

Claims 4-6 each depend from independent base claim 3 and add further limitations. For at least the same reasons that Claim 3 is not shown, taught, or disclosed by the cited references, Claims 4-6 are likewise not shown, taught, or disclosed. Thus, Applicant respectfully submits that the rejection of claims 4-6 should be withdrawn.

b. Claims 1-2

Claim 1 recites similar limitations as claim 3, in method form. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 1. Furthermore, for the same reasons as set for above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 1 should be withdrawn and that claim 1 is now in position for allowance.

Claim 2 depends from independent base claim 1 and adds further limitations. For at least the same reasons that Claim 1 is not shown, taught, or disclosed by the cited references, claim 2 is likewise not shown, taught, or disclosed. Thus, Applicant respectfully submits that the rejection of claim 2 should also be withdrawn.

c. Claim 7

Claim 7 recites similar limitations as claim 3. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 7. Furthermore, for the same reasons as set for above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 7 should be withdrawn and that claim 7 is now in position for allowance.

d. Claims 12-13

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Claim 12 recites similar limitations as claim 3, in method form. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 12. Furthermore, for the same reasons as set forth above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 12 should be withdrawn and that claim 12 is now in position for allowance.

Claim 13 depends from independent base claim 12 and adds further limitations. For at least the same reasons that Claim 12 is not shown, taught, or disclosed by the cited references, claim 13 is likewise not shown, taught, or disclosed. Thus, Applicant respectfully submits that the rejection of claim 13 should also be withdrawn.

e. Claims 14-17

Claim 14 recites similar limitations as claim 3. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 14. Furthermore, for the same reasons as set forth above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 14 should be withdrawn and that claim 14 is now in position for allowance.

f. Claim 18

Claim 18 recites similar limitations as claim 3. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 18. Furthermore, for the same reasons as set forth above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 18 should be withdrawn and that claim 18 is now in position for allowance.

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g. Claim 19

Claim 19 recites similar limitations as claim 3. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 19. Furthermore, for the same reasons as set for above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 9 should be withdrawn and that claim 19 is now in position for allowance.

h. Claim 20

Claim 20 recites similar limitations as claim 3. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 20. Furthermore, for the same reasons as set for above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 9 should be withdrawn and that claim 20 is now in position for allowance.

i. Claim 21

Claim 21 recites similar limitations as claim 3. For the same reasons that Gotou does not meet the limitations of claim 3, Gotou also does not meet the limitations of claim 21. Furthermore, for the same reasons as set for above in the arguments to claim 3, none of the references of record may even be combined to formulate an obvious-type rejection under 35 U.S.C. § 103. Accordingly, Applicant respectfully submits that the 35 U.S.C. § 102 rejection of claim 9 should be withdrawn and that claim 21 is now in position for allowance.

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Conclusion

In view of the foregoing remarks, it is respectfully submitted that none of the references cited by the Examiner taken alone or in any combination shows, teaches, or discloses the claimed invention, and that Claims 1-7 and 12-21 are in condition for allowance. Reexamination and reconsideration are respectfully requested.

Should the Examiner have any questions regarding this amendment, or should the Examiner believe that it would further prosecution of this application, the Examiner is invited to call the undersigned.

Respectfully submitted,

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